

disclaimer, while claims 13-17, 19-22, 25, 38-42, 44-47, 49, 50, 63-67, 69, 71, 72, 75, 83, 85, 88-96 and 99-112 have been amended to clarify features of the subject invention. Support for these changes can be found in the original application as filed. Therefore, no new matter has been added. Also, Applicants reserve the right to file a divisional application directed to the subject matter of the non-elected claims.

Applicants note with appreciation that claims 38-50, 63-75, 83, 85-99 and 104-125 would be allowable if rewritten or amended to overcome the rejection under 35 U.S.C. § 112, second paragraph, discussed below. For the reasons discussed below, Applicants submit that this rejection has been overcome. Therefore, these claims should be deemed allowable at the outset. In addition to these claims being allowable, Applicants submit that independent claims 13-16, and claims 100-103 and 113-116, respectively depending therefrom, likewise should be deemed allowable over the cited art.

Applicants request favorable reconsideration and withdrawal of the rejections set forth in the above-noted Office Action.

Claims 13-25, 38-50, 63-75, 83 and 85-125 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite. The Examiner objected to a specific recitation in these claims. To expedite prosecution, Applicants have amended the pending claims in light of the Examiner's comments. Applicants submit that these changes overcome this rejection. Such favorable indication, and allowance of the noted claims, are requested.

Turning now to the art rejections, claims 13-25 and 100-103 were rejected under 35 U.S.C. § 102 as being anticipated by either U.S. Patent No. 5,392,094 to Kudo or by U.S.

Patent No. 5,467,166 to Shiraishi. Applicants submit that these patents do not teach or suggest many features of the present invention, as previously recited in independent claims 13-16. Therefore, these rejections are respectfully traversed. In addition, Applicants submit that independent claims 13-16, as presented, amplify the distinctions between the present invention and the cited art.

Independent claims 13-16 relate to various aspects of exposure apparatus. These claims recite, among other features, first exposure means and second exposure means, wherein a first exposure by the first exposure means and a second exposure by the second exposure means are carried out prior to a development process.

As recited in independent claim 13, the first exposure means illuminates a predetermined mask with light of a predetermined wavelength under a first illumination condition, to print a first pattern on a predetermined exposure region, whereas the second exposure means illuminates the predetermined mask with light of the predetermined wavelength under a second illumination condition, different from the first illumination condition, to print a second pattern on the predetermined exposure region.

As recited in independent claim 14, the first exposure means illuminates a predetermined mask with a first signal to print a first pattern on a predetermined exposure region, whereas the second exposure means illuminates the predetermined mask with a second signal, different from the first signal, to print a second pattern on the predetermined exposure region.

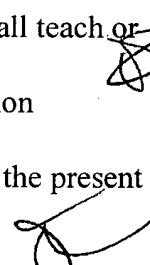
In yet another aspect, as recited in independent claim 15, the first exposure means illuminates a predetermined mask with light of a first numerical aperture to print a first pattern on a predetermined exposure region, whereas the second exposure means illuminates the predetermined mask with light of a second numerical aperture, different from the first numerical aperture, to print a second pattern on the predetermined exposure region.

In still another aspect, as recited in independent claim 16, the first exposure means obliquely illuminates a predetermined mask to print a first pattern on a predetermined exposure region, whereas the second exposure means perpendicularly illuminates the predetermined mask to print a second pattern on the predetermined exposure region.

Accordingly, in the present invention, recited in independent claims 13-16, a mask can be illuminated by first and second exposure means under different illumination conditions, respectively, whereby a first pattern and a second pattern can be printed on the exposure region. In this manner, the first and second patterns can be different from the “mask pattern,” or they can be different from each other. In addition, in the present invention recited in independent claims 13-16, a first exposure by the first exposure means and a second exposure by the second exposure means are carried out prior to a development process. In this manner, in the first and second exposures, the mask can be illuminated under first and second illumination conditions, respectively, which can be different from each other. Applicants submit that the cited art does not teach or suggest such features of the present invention, as recited in independent claims 13-16.

The Kudo patent relates to an illumination optical system in which a parallel beam supplying unit supplies parallel beams. A first optical integrator forms substantially first surface illuminants by the beams coming from the parallel beam supplying unit. A first converging optical system converges the beams from the plurality of secondary illuminants and a second optical integrator forms substantially second surface illuminants by the plurality of converged beams. A second converging optical system converges the beams from the second surface illuminants formed through the second optical integrator and illuminates an irradiated surface with the converged beams in superposition. At least one of the first optical integrator and the first converging optical system includes plural lens systems interchangeable with each other and having focal lengths different from each other. One of the plurality of lens units is inserted in a light path, and the size of the second surface illuminants is thereby made variable while maintaining an irradiated area having a fixed size.

Accordingly, the exposure apparatus in the Kudo patent has a first aperture variable means and a second variable aperture stop. This patent, however, does not at all teach or suggest performing first and second exposures under different mask illumination conditions, respectively, and prior to a development process, in the manner of the present invention recited in independent claims 13-16.

A handwritten scribble consisting of several overlapping loops and lines, located to the right of the text in the second paragraph.

The Shiraishi patent discloses an arrangement to effect projection exposure at a great depth of focus without spoiling transfer fidelity even for a plurality of isolated patterns relatively close to one another. A coherence reducing member reduces the coherency

between imaging light in a central circular transmitting portion FA on or near the pupil plane (Fourier transform plane) of a projection optical system and imaging light in a marginal zonal transmitting portion FB. A double focalizing member DFM makes the in-focus position of light pass through the circular transmitting portion FA. The in-focus position of light passing through the zonal transmitting portion FB differs in the direction of the optical axis of the projection optical system.

Accordingly, the Shiraishi patent relates to an exposure apparatus having a mechanism at the pupil position of a projection optical system for locally changing the polarization direction and for changing the focus position. Although that patent teaches changing the characteristic of the projection optical system, the illumination condition for illuminating the mask is unchanged. Therefore, the Shiraishi patent, as with the Kudo patent, does not teach or suggest performing first and second exposures under different mask illumination conditions, and prior to a development process, in the manner of the present invention recited in independent claims 13-16.

For the foregoing reasons, Applicants submit that the present invention, as recited in independent claims 13-16, also is patentably defined over the cited.

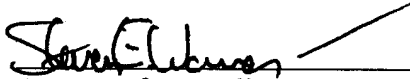
Dependent claims 100-103 and 113-116 also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in their respective independent claims. Further individual consideration of these dependent claims is requested.

Applicants submit that this Amendment After Final Rejection clearly places this application in condition for allowance. This Amendment was not earlier presented because Applicants believed that the prior Amendment placed the application in condition for allowance. Accordingly, entry of the instant Amendment, as an earnest attempt to advance prosecution and reduce the number of issues, is requested under 37 CFR 1.116.

Favorable reconsideration, withdrawal of the rejections set forth in the above-noted Office Action and an early Notice of Allowance are also requested.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010. All correspondence should be directed to our address listed below.

Respectfully submitted,



Attorney for Applicants
Steven E. Warner
Registration No. 33,326

FITZPATRICK, CELLA, HARPER & SCINTO
30 Rockefeller Plaza
New York, New York 10112-3801
Facsimile: (212) 218-2200
SEW/eab



Application No. 09/337,040
Attorney Docket No. 00684.002864

APPENDIX A

IN THE CLAIMS

13. (Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask [pattern] with light of a predetermined wavelength under a first illumination condition, to print [the same] a first pattern on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask [pattern] with light of the predetermined wavelength under a second illumination condition, different from the first illumination condition, to print [the same] a second pattern on the predetermined exposure region,

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

14. (Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask [pattern] with a first sigma to print [the same] a first pattern on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask [pattern] with a second sigma, different from the first sigma, to print [the same] a second pattern on the predetermined exposure region[;],

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

15. (Amended) An exposure apparatus, comprising:

first exposure means for [illumination] illuminating a predetermined mask [pattern] with light of a first [NA] numerical aperture to print [the same] a first pattern on a predetermined exposure region; and

second exposure means for illuminating the predetermined mask [pattern] with light of a second [NA] numerical aperture, different from the first [NA] numerical aperture, to print [the same] a second pattern on the predetermined exposure region[;],

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

16. (Amended) An exposure apparatus, comprising:

first exposure means for obliquely illuminating a predetermined mask [pattern] to print [the same] a first pattern on a predetermined exposure region; and

second exposure means for perpendicularly illuminating the predetermined mask [pattern] to print [the same] a second pattern on the predetermined exposure region, wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

17. (Amended) An apparatus according to any one of Claims 13 - 16, wherein the mask [pattern] includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

19. (Amended) An apparatus according to Claim 17, wherein the mask [pattern] includes a phase shift pattern.

20. (Amended) An apparatus according to Claim 17, wherein there is a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, disposed adjacent to the mask [pattern].

21. (Amended) An apparatus according to any one of Claims 13 - 16, wherein the mask [pattern] is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

22. (Amended) An apparatus according to any one of Claims 13 - 16, wherein the mask [pattern] is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

25. (Amended) A device manufacturing method, comprising the steps of:
exposing a wafer [with a mask pattern] to a pattern on a mask by use of an exposure apparatus as recited in any one of Claims 13- 16; and
developing the exposed wafer.

38. (Amended) An exposure apparatus [for illuminating a predetermined mask pattern with an illumination system and for projecting light from the mask pattern onto a predetermined exposure region through a projection system to print the mask pattern on the exposure region, said apparatus] comprising:

an illumination optical system for illuminating a predetermined mask;
a projection optical system for projecting light from the mask to a
predetermined exposure region;

first exposure means for illuminating the mask [pattern] under a first illumination condition and for projecting light from the mask [pattern] to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with [the same] a second pattern; and

second exposure means for illuminating the mask [pattern] under a second illumination condition, different from the first illumination condition, and for projecting light from the mask [pattern] to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with [the same] a second pattern[:]

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

39. (Amended) An exposure apparatus [for illuminating a predetermined mask pattern with an illumination system and for projecting light from the mask pattern onto a predetermined exposure region through a projection system to print the mask pattern on the exposure region, said apparatus] comprising:

an illumination optical system for illuminating a predetermined mask;

a projection optical system for projecting light from the mask to a predetermined exposure region;

first exposure means for illuminating the mask [pattern] with a first sigma and for projecting light from the mask [pattern] to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with [the same] a first pattern; and

second exposure means for illuminating the mask [pattern] with a second sigma, different from the first sigma, and for projecting light from the mask [pattern] to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with [the same] a second pattern[:]

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

40. (Amended) An exposure apparatus [for illuminating a predetermined mask pattern with an illumination system and for projecting light from the mask pattern onto a predetermined exposure region through a projection system to print the mask pattern on the exposure region, said apparatus] comprising:

an illumination optical system for illuminating a predetermined mask;

a projection optical system for projecting light from the mask to a predetermined exposure region;

first exposure means for illuminating the mask [pattern] with a first [NA] numerical aperture and for projecting light from the mask [pattern] to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with [the same] a first pattern; and

second exposure means for illuminating the mask [pattern] with a second [NA] numerical aperture, different from the first [NA] numerical aperture, and for projecting light from the mask [pattern] to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with [the same;] a second pattern.

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

41. (Amended) An exposure apparatus [for illuminating a predetermined mask pattern with an illumination system and for projecting light from the mask pattern onto a predetermined exposure region through a projection system to print the mask pattern on the exposure region, said apparatus] comprising:

an illumination optical system for illuminating a predetermined mask;

a projection optical system for projecting light from the mask to a predetermined exposure region;

first exposure means for obliquely illuminating the mask [pattern] and for projecting light from the mask [pattern] to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with [the same] a first pattern; and

second exposure means for perpendicularly illuminating the mask [pattern] and for projecting light from the mask [pattern] to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with [the same] a second pattern.[:]

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

42. (Amended) An apparatus according to any one of Claims 38 - 41, wherein the mask [pattern] includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

44. (Amended) An apparatus according to Claim 42, wherein the mask [pattern] includes a phase shift pattern.

45. (Amended) An apparatus according to any one of Claims 38 - 41, wherein one of a shape of an aperture opening of the projection optical system and a transmission factor distribution is changed to change the spatial frequency passage spectrum of the projection optical system.

46. (Amended) An apparatus according to any one of Claims 38 - 41, wherein the mask [pattern] is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

47. (Amended) An apparatus according to any one of Claims 38 - 41, wherein the mask [pattern] is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

49. (Amended) An apparatus according to any one of Claims 38 - 41, wherein exposures of the exposure region under different illumination conditions are performed simultaneously without interference of lights [different] in the different illumination conditions.

50. (Amended) A device manufacturing method, comprising the steps of:
 exposing a wafer [with a mask pattern] to a pattern on a mask by use of an exposure apparatus as recited in any one of Claims 38 - 41; and
 developing the exposed wafer.

63. (Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask [pattern] with light of a predetermined wavelength under a first illumination condition, to print [the same] a first pattern on a predetermined exposure region; and

second exposure means for illuminating the mask [pattern] with light of the predetermined wavelength under a second illumination condition, different from the first illumination condition, to print [the same] a second pattern on the predetermined exposure region[;],

wherein the mask [pattern] has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern[;], and

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

64. (Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask [pattern] with light of a first sigma, to print [the same] a first pattern on a predetermined exposure region; and

second exposure means for illuminating the mask [pattern] with light of a second sigma, different from the first sigma, to print [the same] a second pattern on the predetermined exposure region[;],

wherein the mask [pattern] has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern[;], and

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

65. (Amended) An exposure apparatus, comprising:

first exposure means for illuminating a predetermined mask [pattern] with light of a first [NA] numerical aperture, to print [the same] a first pattern on a predetermined exposure region; and

second exposure means for illuminating the mask [pattern] with light of a second [NA] numerical aperture, different from the first [NA] numerical aperture, to print [the same] a second pattern on the predetermined exposure region[;],

wherein the mask [pattern] has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern[;], and

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

66. (Amended) An exposure apparatus, [_]comprising:

first exposure means for [obliquely] obliquely illuminating a predetermined mask [pattern], to print [the same] a first pattern on a predetermined exposure region; and

second exposure means for perpendicularly illuminating the mask [pattern] to print [the same] a second pattern on the predetermined exposure region[;],

wherein the mask [pattern] has a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern[;], and

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

67. (Amended) An apparatus according to any one of Claims 63 - 66, wherein the mask [pattern] includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

69. (Amended) An apparatus according to Claim 67, wherein the mask [pattern] includes a phase shift pattern.

71. (Amended) An apparatus according to any one of Claims 63 - 66, wherein the mask [pattern] is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

72. (Amended) An apparatus according to any one of Claims 63 - 66, wherein the mask [pattern] is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

75. (Amended) A device manufacturing method, comprising the steps of:
 exposing a wafer [with a mask pattern] to a pattern on a mask by use of an exposure apparatus as recited in any one of Claims 63 - 66; and
 developing the exposed wafer.

83. (Amended) An exposure apparatus [for illuminating a predetermined mask pattern with an illumination system and for projecting light from the mask pattern onto a predetermined exposure region through a projection system to print the mask pattern on the exposure region, said apparatus] comprising:

an illumination optical system for illuminating a predetermined mask;

a projection optical system for projecting light from the mask to a predetermined exposure region;

 first exposure means for illuminating the mask [pattern] under a first illumination condition and for projecting light from the mask [pattern] to the exposure region at a first spatial frequency passage spectrum of the projection system, so that the exposure region is exposed with [the same] a first pattern; and

second exposure means for illuminating the mask [pattern] under a second illumination condition, different from the first illumination condition, and for projecting light from the mask [pattern] to the exposure region at a second spatial frequency passage spectrum of the projection system, different from the first spatial frequency passage spectrum, so that the exposure region is exposed with [the same] a second pattern,

wherein the mask [pattern] has a repetition pattern comprising repeatedly disposed basic patterns, being defined by light transmissive portions,

wherein light passed through adjacent basic patterns of the repetition pattern have a mutual optical phase difference of about 180 deg., and

wherein [exposures by said first and] a first exposure by said first exposure means and a second exposure by said second exposure means are carried out prior to a development process.

85. (Amended) An exposure apparatus according to Claim 83, wherein the basic pattern comprises a pair of transmissive patterns, [wherein] and corresponding light transmissive portions of the pair of transmissive patterns have a mutual optical phase difference of about 180 deg.

88. (Amended) An exposure apparatus according to Claim 83, wherein the illumination condition is changed upon switching of multiple exposures by use of

illumination stop holding means having plural illumination stops, one of which can be detachably inserted into a light path of the illumination optical system.

89. (Amended) An exposure apparatus according to Claim 83, wherein there are a light blocking plate having at least one opening and holding means for the light blocking plate, and [wherein] the illumination condition is changed by use of light blocking plate rotating means for rotationally moving the light blocking plate within the illumination optical system, upon switching of the multiple exposures.

90. (Amended) An apparatus according to Claim 83, wherein said first exposure means illuminates the mask [pattern] with a first sigma, and [wherein] said second exposure means illuminates the mask [pattern] with a second sigma, different from the first sigma.

91. (Amended) An apparatus according to Claim 83, wherein said first exposure means illuminates the mask [pattern] with a first [NA] numerical aperture, and [wherein] said second exposure means illuminates the mask [pattern] with a second [NA] numerical aperture, different from the first [NA] numerical aperture.

92. (Amended) An apparatus according to Claim 83, wherein said first exposure means illuminates the mask [pattern] obliquely, and [wherein] said second exposure means illuminates the mask [pattern] perpendicularly.

93. (Amended) An apparatus according to Claim 83, wherein the mask [pattern] includes an opening pattern with a linewidth not greater than a resolution limit of an exposure apparatus to be used.

94. (Amended) An apparatus according to Claim 83, wherein [there is] a desired pattern and an auxiliary pattern having a shape different from that of a repetition of the desired pattern, are disposed adjacent to [the mask pattern] a pattern on the mask.

95. (Amended) An apparatus according to Claim 83, wherein the mask [pattern] is illuminated with light from one of a KrF excimer laser, an ArF excimer laser and an F₂ excimer laser.

96. (Amended) An apparatus according to Claim 83, wherein the mask [pattern] is projected by use of a projection optical system comprising one of a dioptric system, a catadioptric system and a catoptric system.

99. (Amended) A device manufacturing method, comprising the steps of:
 exposing a wafer [with a mask pattern] to a pattern on a mask by use of an
exposure apparatus as recited in Claim 83; and
 developing the exposed wafer.

100. (Amended) An apparatus according to Claim 13, wherein the illumination of the mask [pattern] is performed with bright field illumination.

101. (Amended) An apparatus according to Claim 14, wherein the illumination of the mask [pattern] is performed with bright field illumination.

102. (Amended) An apparatus according to Claim 15, wherein the illumination of the mask [pattern] is performed with bright field illumination.

103. (Amended) An apparatus according to Claim 16, wherein the illumination of the mask [pattern] is performed with bright field illumination.

104. (Amended) An apparatus according to Claim 38, wherein the illumination of the mask [pattern] is performed with bright field illumination.

105. (Amended) An apparatus according to Claim 39, wherein the illumination of the mask [pattern] is performed with bright field illumination.

106. (Amended) An apparatus according to Claim 40, wherein the illumination of the mask [pattern] is performed with bright field illumination.

107. (Amended) An apparatus according to Claim 41, wherein the illumination of the mask [pattern] is performed with bright field illumination.

108. (Amended) An apparatus according to Claim 63, wherein the illumination of the mask [pattern] is performed with bright field illumination.

109. (Amended) An apparatus according to Claim 64, wherein the illumination of the mask [pattern] is performed with bright field illumination.

110. (Amended) An apparatus according to Claim 65, wherein the illumination of the mask [pattern] is performed with bright field illumination.

111. (Amended) An apparatus according to Claim 66, wherein the illumination of the mask [pattern] is performed with bright field illumination.

112. (Amended) An apparatus according to Claim 83, wherein the illumination of the mask [pattern] is performed with bright field illumination.

DC_MAIN 89591 v 1